Zebrafish Locomotor Responses Predict Irritant Potential of Smoke Particulate Matter from Five Biomass Fuels

WK Martin[1], S Padilla[2], YH Kim[3], MD Hays[4], DL Hunter[2], MS Hazari[3], MI Gilmour[3], AK Farraj[3]

[1]Oak Ridge Institute for Science and Education, Oak Ridge, TN;

[2]ISTD, [3]EPHD, and [4]APPCD, USEPA, RTP, NC

Over the past few decades, the drying and warming trends of global climate change have increased wildland fire (WF) season length, as well as geographic area impacted. Consequently, exposures to WF fine particulate matter (PM2.5; aerodynamic diameter <2.5 μm) are likely to increase in frequency and duration, contributing to a growing public health burden. Given the influence of fuel type and combustion conditions on WFPM2.5 compositions, there is pressing need to identify the biomass fuel sources and emission constituents that drive toxicity. Previously, we reported the utility of 6-day post-fertilization (dpf) zebrafish larvae in evaluating diesel exhaust PM-induced irritation, demonstrating responses analogous to those in mammals. In the present study, combustions, separated by smoldering or flaming conditions, of pine needles, red oak, pine, eucalyptus, and peat were achieved using an automated tube furnace paired with a cryo-trapping apparatus to collect condensates of emissions. The condensates were extracted and prepared for use in zebrafish assays. We hypothesized that 1) the extractable organic fractions of biomass smoke PM will elicit dose-dependent irritant responses in 6-dpf zebrafish larvae, and 2) the relative potencies will vary across biomass emissions, potentially driven by varying chemical composition. Six-dpf zebrafish (n= 28-32/group) were exposed acutely to PM extracts (5 concentrations; 0.3-30 μg/ml; half-log intervals) and activity was assessed in the dark using video tracking software. Extracts collected from five smoldering emissions elicited dose-dependent increases ($p<0.001$) in locomotor activity. Preliminary analysis of rank order potencies indicates that for smoldering conditions, the red oak and pine are most potent. Evaluation of the impacts of flaming burn conditions are in progress. In conclusion, the zebrafish assay is sensitive across a wide PM extract dose range and allows for rapid determination of relative potencies of multiple biomass PM sources. The differential potencies of the biomass emissions may be, in part, a response to variability in chemical composition among the biomass PM samples. (This abstract does not reflect US EPA policy).